nection with a study of the geysers. The altitudes of the geyser basins above sea-level have been ascertained by long series of barometric readings, continued through several seasons. In conducting a series of observations upon the boiling-points of the thermal waters in the park, Dr. William Hallock, who had charge of this special investigation, determined the theoretical boiling-point by noting the mean daily readings of the mercurial column. The exact boiling-point of a pure surface-water, obtained from a neighboring mountain-stream, and the boiling-point of the thermal waters from the springs, were determined from actual experiments by heating over a fire, employing every possible precaution to avoid sources of error. Surface-waters and deep-seated mineral waters gave the same results, and coincided with the calculated boiling-point at this altitude. Hundreds of observations have been carefully taken where the waters in the active and running springs boiled at temperatures between 198° and 199° F.

As will be shown later in this paper, the thermal waters are solutions of mineral matter too dilute to be affected to any appreciable extent as regards their boiling-point by their dissolved contents. The theoretical boiling-point for the springs and pools in the Upper Geyser Basin may be taken at 92.5° C. (198.5° F.). In many of the large caldrons, where the water remains quiet, a temperature has been recorded of 94° C. (201.2° F.) without the usual phenomena of boiling. This gives a body of superheated water, with a temperature at the surface of 1.5° C. (2.7° F.) above the point necessary to produce explosive action. Thermometers plunged into the basins show slightly varying temperatures, dependent upon their position in the basin. They indicate the existence of numerous currents, and a very unstable equilibrium of the heated waters, which are liable, under slight changes, to burst forth with more or less violence. It is under these conditions that geyser-action can be accelerated by artificial means. If into one of these superheated basins a handful of sinter pebbles be thrown, or the surface of the water be agitated by the rapid motion of a stick or cane, or even by lashing with a rope, a liberation of steam ensues. This is liable to be followed by a long boiling of the water in the pool, which in turn may lead to geyser-action. There is some reason to believe that, at least in one instance, an eruption has been brought about by a violent but temporary gust of wind, which either ruffled the water or disturbed the equilibrium of the pool, and changed momentarily the atmospheric pressure.

In Iceland, travellers have long been accustomed to throw into the geysers turf and soft earth from the bogs and meadows which abound in the neighborhood, the effect produced being much the same as that of sinter pebbles and gravel upon the geysers in the National Park. So well was this understood, that at one time a peasant living near the Iceland locality kept a shovel solely for the accommodation of those visiting the geysers.

In my letter to Dr. Raymond, I mention the curious fact that the laundryman's spring, now known as the Chinaman, in which geyser-action may most easily be produced by artificial means, has never been regarded by the Geological Survey as any thing but a hot-spring; and no one has ever seen it in action without the application of soap, except in one instance, when it was made to play to a height of twenty feet after stirring it vigorously with a pine bough for nearly ten minutes. In our records it is simply known as a spring.

If soap or lye is thrown into most of the small pools, a viscous fluid is formed; and viscosity is, I think, the principal cause in hastening geyser-action. Viscosity must tend to the retention of steam within the basin, and, as in the case of the superheated waters, where the temperature stands at or above the boiling-point, explosive liberation must follow. All alkaline solutions, whether in the laboratory or in nature, exhibit, by reason of this viscosity, a tendency to bump and boil irregularly. Viscosity in these hot-springs must also tend to the formation of bubbles and foam when the steam rises to the surface; and this, in turn, aids to bring about the explosive action, followed by a relief of pressure, and thus to hasten the final and more powerful display. Of course, relief of pressure of the superincumbent waters upon the column of water below the surface basin is essential to all eruptive action. These conditions, it seems to me, are purely physical. Undoubtedly the fatty substances contained in soap aid the alkali in rendering the water viscous. On the other hand, when concentrated lye is used, it acts with greater energy, and furnishes a viscous fluid where soap would yield only surface suds, insufficient to accomplish any phenomenal display.

It is well known that saturated solutions of mineral substances raise the boiling-point very considerably, the temperature having been determined for many of the alkaline salts. In general, I believe the boiling-point increases in proportion to the amount of salt held in solution. Actual tests have shown that the normal boiling-point of silicious waters in the park does not differ appreciably from the ordinary surface-waters; mainly, I suppose, because they are extremely dilute solutions.

The amount of lye required to produce a sufficiently viscous condition of the waters increases but slightly the percentage of mineral matter held in solution.

All the waters of the principal geyser-basins present the closest resemblance in chemical composition, and, for the purposes of this paper, may be considered as identical in their constituents. They have a common origin, being, for the most part, surface-waters which have percolated downward for a sufficient distance to come in contact with large volumes of steam ascending from still greater depths. The mineral contents of the hot-springs are mainly derived from the acid lavas of the park plateau, as the result of the action of the ascending steam and superheated waters upon the rocks below. These thermal waters are essentially silicious alkaline waters, carrying the same constituents in somewhat varying quantities, but always dilute solutions, never exceeding two grams of mineral matter per kilogram of water. When cold, they are potable waters, for the most part slightly alkaline to the taste, and probably wholesome enough, unless taken daily for a long period of time.

Dr. Raymond has made the suggestion that the addition of caustic alkali would possibly precipitate some of the mineral ingredients found in these waters, thereby changing their chemical composition sufficiently to affect the point of ebullition. At the same time he remarks that the geyser-waters are probably too dilute solutions to be much influenced by such additions. Any one who glances at the analyses of the waters of the Bee-Hive, Fountain, and Fearless must see, I think, that they are not only too dilute to undergo any marked change of temperature, but that the mineral constituents consist mainly of the carbonates and chlorides of the alkalies, associated with a relatively large amount of free silica, which would remain unacted upon by caustic alkali. There is nothing in the waters to be thrown down by the addition of alkali, or to permit any chemical combinations to be formed by the addition of a small amount of soap. The desire of tourists to "soap a geyser" during their trip through the park grows annually with the increase of travel; so much so, that there is a steady demand for the toilet-soap of the hotels. If visitors could have their way, the beautiful blue springs and basins of the geysers would be "in the suds" constantly throughout the season. Throwing any thing into the hot-springs is now prohibited by the government authorities. It is certainly detrimental to the preservation of the geysers, and the practice cannot be too strongly condemned by all interested in the National Reservation.

THE EAST GREENLANDERS.

CAPT. HOLM'S expedition to East Greenland was as remarkable on account of its geographical results as in regard to the ethnological observations made among the isolated tribes of the northern parts of the east coast of Greenland. The results of his journey have been published, and form the tenth volume of the "Meddelelser om Grönland." In a recent number we referred to the linguistic and folk-loristic papers. Of no less importance are the general anthropometric and ethnographical results of the expedition.

Dr. Sœren Nansen has submitted the craniological material and the measurements of Capt. Holm to an elaborate discussion, from which we glean the following facts. The whole population consisted of 548 heads, 245 of whom were males, while 303 were females. The size of the people is below the average, being 1,647 millimetres; while in the southern parts of the coast the average

size is only 1,604 millimetres on the east coast, and 1,547 on the west coast. The people of East Greenland are not as dolichocephalic as those of other regions, the length-width index of men being 76.9; that of women, 75.6. The face is oval, the lower part being comparatively large. The superior facial index is 103.8; the gonio-zygomatic index, 82.3, — two important figures, as they are the highest of all known indices. The form of the nose varies considerably, but is generally narrow and prominent, frequently aquiline.

Capt. Holm's description of the customs of this people is full of interest. His graphic description is made still more useful by a number of excellent lithographic plates, in which implements and works of art are represented.

During winter, the people of this region inhabit stone houses. In each inhabited place there is only one house, in which as many as ten families dwell. The oldest man acts as chief, as he is or has been a good hunter, and has sons who are good hunters. This position of senior chief rests probably upon a tacit acknowledgment of his authority, which is shown by the fact that he receives visitors, and represents all the inhabitants of the house. The ties of consanguinity are considered as imposing the duty of mutual assistance. Marriage, on the other hand, is not considered a binding tie. It is only after she has had children, that the wife's position becomes somewhat more firmly established. The husband is the chief of the family. Next to him are his sons, even when quite young, because they are considered the future hunters, who provide for the wants of their parents in old age. While the parents are alive, the sons live with them, and feed and clothe them.

The natives of this region frequently marry before they are grown up, as soon as a young man is able to provide for his wife. Good hunters have frequently two wives. As one woman cannot prepare all the skins obtained by the hunter, he frequently takes a second wife at the demand of the first. Sometimes his object in taking a second wife is to have two oarsmen for his boat. No instance is known of a man having more than two wives.

After death, the corpse is clothed in the best winter garments. Men are clothed in their kayak jacket. The head is covered with a hood, the limbs are tied up, and the corpse is dragged without any ceremony through the long passage of the house, or, if this is too difficult, it is removed through the window. If one of his ancestors has perished in the kayak, the corpse is thrown into the sea or deposited on the beach, where it is covered by the rising tide. In winter it is thrown through a hole cut through the ice. Sometimes, at least in former times, the dead were buried under bowlders. The principal implements of the dead are deposited by the side of the grave.

The natives have numerous mourning ceremonies, which consist principally in lamentations and in abstaining from certain kinds of food. The name of the deceased is never mentioned. For this reason, if two men have the same name, the survivor must take a new one. If the deceased had the name of an animal or some other object, the word designating this animal must be changed. Thus the language undergoes material changes, as these new words are adopted by the whole population. But the old words frequently re-appear when the dead one has been forgotten.

Man is believed to be composed of three parts, — the body, the soul, and the name. The soul is small, not larger than a finger, and lives in the body of the man. When it falls sick, the man also falls sick; and if it dies, the man also dies. After the death of a man, his soul revives, either in heaven or in the sea. Both lives after death are considered good, but the former is preferable.

The name is as large as a man, and enters the child when, after birth, it is wiped with some water around the mouth, the names of the deceased after whom it is to be called being pronounced at the same time. When a man dies, the name remains near the corpse, in the water or on the land, until a child receives the name of the deceased. Then it enters the child, and there continues to exist. Still-born children are in heaven, where they produce the northern lights.

The Eskimo of East Greenland believe in a great number of spirits, which, however, are visible only to the angekok, the shamans of the Eskimo. The sea-animals are governed by a giant woman, in whose hair hang seals, narwhals, and other animals. When the angekok is led to her by his guardian spirit, and he combs her hair, the animals come to the coast. Another important spirit is Tornarsuk, who also lives in the sea. He is described as being as tall as a large seal, and partly resembles a seal, partly a man. He swims rapidly through the depths of the sea.

There is an interesting legend which is found all over arctic America. It refers to the Erkilik, the upper part of whom is of human shape, while their feet are those of dogs. It is said that these Erkilik and the Europeans are the descendants of a woman who had married a dog.

These spirits, and the many others of whom the Eskimo tell, are not the subjects of any worship; but, in order to prevent them from doing harm to man, amulets are worn, which are believed to be a means of protection against sickness, and which secure long life to the wearer. Besides this, magic formulas are used in cases of sickness or to avert dangers. These formulas are also used to do harm to one's enemies. They are very ancient, and are transmitted from generation to generation. They are considered particularly effective when applied for the first time by a certain individual, while in course of time they lose in value and power. For this reason they are recited only in cases of imminent danger. They are spoken slowly, and in a low voice. The meaning of the words is entirely unknown.

Every angekok has his Tornarsuk and a being that is intermediate between himself and this Tornarsuk. In order to be a skilful angekok, it is necessary to have command over a great number of spirits. Besides, the angekok must be an expert in jugglery, he must have always a ready answer, and be able to make a diabolical impression upon his audience so as to strongly excite their nerves. The help of the angekok is asked for securing good luck in hunting, to procure favorable winds, and to cure sickness. They are not conversant, however, with the medicinal properties of any plant or mineral, but their operations are confined to treating the soul of the sick person.

It is the belief of the Eskimo that all diseases are due to the soul, which may be hurt or stolen by a sorcerer or by an angekok. It becomes, therefore, the duty of the angekok to find its whereabouts. His guardian spirit informs him of the cause of the disease, and of what has happened to the soul. If it has left the body, the angekok, by the help of his guardian spirit, makes marvellous journeys to recover it.

Besides the angekok, there are real sorcerers, whose principal object it is to do harm to their enemies. They are particularly able to construct the Tupilak, — a fabulous animal, artificially made of bone, skin, and flesh, which is to destroy the enemy of its master. The practices of sorcery of these men are numerous and of varied description; but the greater number are wholly imaginary. They have still other means of doing damage to their enemies; for instance, by using the flesh of a corpse. A man may be a sorcerer without carrying out his art, but then he is liable to fall into fits. In such cases he is slowly starved, and heavy stones are placed on his belly until he dies. This torture is often shortened by throwing the sick one into the sea. The only means of one escaping this treatment is by confessing that he is a sorcerer, and telling all his real and imaginary crimes. It is believed that thus he loses his supernatural powers.

The natives of the east coast of Greenland have an interesting tale stating that Greenland is an island. They say that long ago a man named Uyartek made a journey around the island. In the tale of this voyage, a point is named the end of the land. According to the description, this point is in about 68½° north latitude. Before coming there, a large fiord is said to intersect the coast.

They account for the existence of glaciers in the following way: When the land first made its appearance, there were neither sea nor mountains, but all was an enormous plain. As man was bad, the one in heaven destroyed the earth. Chasms opened, in which man perished. Then the water covered every thing. When land appeared for the second time, it was covered all over with glaciers. Two beings fell from heaven, who repeopled the earth. Since that time the glaciers have continually retreated. There are many places in which traces of their having been once covered by the sea may be seen.

The art of carving is very highly developed. It is a remarkable

fact that in this respect the extreme eastern Eskimo are very much like the inhabitants of Alaska. Among the implements collected by the expedition, are a great number of excellent carvings, — boxes, harpoon-staffs, and other implements, covered all over with carved figures. On all kinds of objects a single ornament is found, representing a seal. Mr. Holm believes that the high development of this art favors the opinion of Dr. H. Rink, who thinks that the East Greenlanders visited the coast coming from the north. He mentions the following facts as favoring this theory: the occurrence of deserted habitations in the northern parts of East Greenland; the undoubted fact that a number of animals reached the east coast coming from the north; and the tale of Uyartek, who travelled all around Greenland. The high development of the art of the East Greenlanders leads him to think that they were in contact with the far-distant Alaskan tribes at a comparatively recent date, while they must have been separated for a long time from the West Greenlanders.

THIRD ANNUAL REPORT OF THE DAIRY COMMISSIONER OF NEW JERSEY.

THE third annual report of the dairy commissioner of New Jersey, being the report for 1888, is full of interesting material. Dr. William K. Newton's long experience in work of this kind renders his reports of great value to all health-officers engaged in discovering the many frauds practised on consumers. Of 623 articles of food analyzed, 303, or 48.64 per cent, were adulterated or below the legal standards. We have not space in which to consider them all in detail, but will select a few of the most important. Of butter and oleomargarine, 68 samples were examined, and 44 of them were found to be adulterated or not standard. Many samples were submitted supposed to be oleomargarine, but they proved to be bad butter. Dr. Newton says that it may be stated as an invariable rule, that if the suspected material is rancid, and has a disagreeable odor, it is inferior butter, and not oleomargarine. The latter may become granular, and have a disagreeable, greasy taste; but it never turns rancid. Of 121 samples of milk, 43 were not as required by law. Adulteration is now practically confined to the large cities. The general milk is excellent. Of 55 samples of American canned goods analyzed, but one was found not up to the standard. During the year, of tomatoes alone, 3,319,437 cans were packed in the United States, 789,363 of them being put up in New Jersey. In speaking of the alleged danger from these goods, Dr. Newton says that it has been his practice for the past few years to investigate all reports of poisoning supposed to be due to the eating of canned articles, but in no instance has he found a well-authenticated case of poisoning. On this subject he says,—

"It is claimed that lead and tin have been found in large quantities in canned vegetables. My investigations have never revealed a single case where lead was in quantities large enough to detect. If that metal is present in these preserved foods, immediate steps should be taken to prevent the sale of articles so contaminated; for it is well known that the constant ingestion of very minute quantities of lead and some of its salts is almost invariably followed by symptoms of poisoning. And these symptoms are well marked, and known to every physician: hence, if there are cases of lead-poisoning due to this cause, a short time only would elapse before they would be placed on record. Lead is a cumulative poison, and is very slowly cast out by the system; but the ingestion of quantities as small as $\frac{1}{24}$ or $\frac{1}{100}$ of a grain, for a time is almost certain to be followed by symptoms of poisoning. I mention these well-known facts for the following reasons: first, if there have been cases of lead-poisoning caused by the use of canned foods contaminated with this metal, the medical profession would have, ere this, published accounts of the cases; second, the contrast between this metal and tin is so marked that the mere mention of the facts will be convincing.

"There is no doubt but that tin is frequently found in the articles preserved in vessels made of that metal. Especially so is this the case with acid vegetables like tomatoes, and the tables given show how often it has been revealed by the analyses just concluded. This being the case, the question is naturally asked, Is this metal poisonous, or are the quantities detected of any importance? Tin is commonly considered, next to iron, one of the most innocuous of the baser metals. Nearly all of our culinary vessels are made of it, and their use is never followed by any ill results. All the evidence regarding the effects of tin on the system is negative. There are no recorded cases of poisoning, and, in fact, no mention is made in the authoritative works on toxicology of tin as a dangerous metal. The only instances where poisonous properties have been claimed for tin are in the records of cases of adulteration of molasses by a certain salt of that metal. Such cases were tried in the Massachusetts courts, but the evidence was not conclusive. We may, then, accept the facts in this relation, and state, that so far as scientific records now go, and so far as evidence is recorded, the quantity and quality of tin as found in canned foods are not injurious."

Mr. Shippen Wallace, chemist of the Board of Health, says that the fact cannot be too thoroughly impressed on the community, that the present system of canning vegetables is of inestimable value; but the same rules should be followed which are made use of with fresh vegetables in their use; that is to say, if, on opening a can, the contents are spoiled, act as one would with fresh vegetables under similar circumstances,—throw them away. This done, there is no possible danger in their use; but if not, the same risk is run as would be in the use of spoiled fresh vegetables, only to a greater extent.

In examining canned asparagus, a large amount of tin was found, and the interior of the can was invariably blackened. This may come from the acid in the asparagus, or from some ingredients used in the process of canning. From the results of the examination of asparagus packed in tin, it would seem to be demonstrated that this vegetable should be put up in glass only, and that the use of tin should be abandoned. Dr. Newton further says, that, of all cases of sickness caused by eating canned goods, the cause has always been found to have been that the contents were spoiled when opened, or the can had been allowed to remain open for a day or more before the contents were used.

Of six samples of ground coffee examined, 8 were pure and 16 adulterated. The adulterants were roasted and ground peas, beans, wheat, and chiccory. The examination of tea showed that while there is no adulteration, there is a large amount of inferior and debased tea used in New Jersey.

Of 415 samples of drugs examined, 231 were found of inferior quality. Of 95 samples of cream-of-tartar, but 46 were up to the standard. Few articles are so commonly debased as this one. In speaking of this, Dr. Newton says, —

"The adulterations detected, in the greater number of debased samples, were clearly intentional, and were not due to lack of care in the methods of manufacture. An excess of tartrate or traces of chloride may well be considered as due to want of skill, or lack of care, in the maker; but the presence of sulphates, phosphates, alum, and flour can be accounted for in one way only, that is, they were added for fraudulent purposes.

"Several unique samples were examined. One, purchased at Beverly, contained no cream-of-tartar, but was a mixture of flour, acid phosphate of lime, and sulphate of lime; another sample of the same kind was sold to one of my agents at Cape May. A sample was sold by a dealer at Pemberton that proved to be a mixture of alum, phosphate of lime, and 64 per cent of cream-of-tartar. Several were obtained in different parts of the State that were adulterated with impure acid phosphate of lime.

"The samples that were equal to the standard were, in at least 90 per cent of the cases, obtained from druggists, but many from this source were badly debased. The impure cream-of-tartar obtained in this State came largely from the Southern and Western sections, and was sold to dealers by agents and jobbers from Philadelphia. There appears to be a certain relation between the fertilizer trade in that city and the bogus cream-of-tartar business, the connection probably being due to the trade in impure phosphates.

"Two suits were instituted against dealers in the very impure article, these being settled on the payment of costs, when the dealer promised to return the adulterated article to the wholesale dealer, and to sell only the pure article. Warning notices were sent to all other dealers detected in selling adulterated cream-of-tartar."